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The impact of doubt on the experience of regret☆

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ABSTRACT

Decisions often produce considerable levels of doubt and regret, yet little is known about how these experiences are related. In six sets of studies (and two pilot-studies; total $N = 2268$), we consistently find that doubts arising *after* a decision (i.e., when people start questioning whether they made the correct decision) intensify regret via increased feelings of blame for having made a poor choice. These results are consistent with decision justification theory (Connolly & Zeelenberg, 2002) and regret regulation theory (Zeelenberg & Pieters, 2007), yet inconsistent with subjective expected pleasure theory (SEP; Mellers, Schwartz, & Ritov, 1999). That is, SEP would have predicted less regret as those who already doubted their decision should be less surprised when learning that their decision indeed could have been better (as compared to those who were certain that they made the correct decision). We find mixed results for the effect of post-decisional doubt on the experience of relief and no support for a relationship between a person's degree of doubt *before* a decision and the intensity of regret. Implications and future directions are discussed.

1. Introduction

Most people readily recognize that decisions often produce considerable levels of doubt and regret: we are conflicted which option to choose before reaching a decision, we start doubting whether we made the correct decision afterwards, and we feel regret when learning that the outcome could have been better if we had chosen differently. Although doubt and regret often accompany one another, little is known about how these experiences are related. Do we regret our choices more or less after an instance of doubt? When and why would doubt affect the experience of regret? The goal of this research is to provide more insight into these matters.

Regret is a universal human emotion, experienced similarly in different cultures (Breugelmans, Zeelenberg, Gilovich, Huang, & Shani, 2014). Regret is the unpleasant feeling when realizing that the outcome could have been better if we had chosen the alternative course of action. As such, regret is felt most intense when there is full knowledge of the outcomes obtained and forgone, a conjecture already noted by Bell (1983) who argued that "key to the identification of regret as a factor in decision making under uncertainty is the hypothesis that it may matter whether a foregone lottery is resolved or not." (p. 1165). Many studies have focused upon testing this resolution and found that decision makers indeed anticipate and experience regret most intense when they learn the outcome of both the chosen and the forgone option (e.g., Boles & Messick, 1995; Coricelli, et al., 2005; Larrick & Boles, 1995; Ritov, 1996; Ritov & Baron, 1995; Van Dijk & Zeelenberg, 2005; Zeelenberg, Beattie, Van der Pligt & De Vries, 1996).

Regret is also a frequently experienced and expressed emotion. For example, by analyzing audio-taped conversations of 26 dyads, Shimanoff (1985) found that regret was the most frequently named negative emotion in everyday conversations and we obtained similar findings when analyzing more modern forms of communication. Specifically, when we monitored all English twitter conversations for 30 days and analyzed how frequent people expressed the emotions regret and disappointment (two prototypical decision-related emotions), people tweeted about regret most frequently (1.306.624 tweets) while the emotion disappointment was mentioned only 270.215 times.[1]

Because regret is such an ubiquitous and aversive emotion, (anticipated) regret affects decisions in a variety of domains like financial decision making (De Bondt & Thaler, 1995; Strahilevitz, Odean, & Barber,

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[1] The same pattern emerged in various other languages (June 3rd–July 3rd 2015).

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2011), negotiations (Larrick & Boles, 1995), trust decisions (Martinez & Zeelenberg, 2015), and even decisions about whether to participate in a lottery or not (Zeelenberg & Pieters, 2004). In a similar vein, research has identified (anticipated) regret as an important mechanism in explaining why individuals and organizations persist to invest resources in failing courses of action (Wong & Kwong, 2007; Ku, 2008). Given the impact of regret on organizational- and daily life decisions, it is important to further develop our insight into the psychology of regret. The present article tries to enhance our understanding of regret by investigating how it is related to another prevalent decision-related experience: doubt.

2. Decisional doubt

Doubt refers to the subjective uncertainty that people experience when assessing the correctness of their decisions, beliefs, or opinions and in the context of decision-making it is useful to distinguish between two different instances of doubt. The first type concerns the doubt that arises *before* reaching a decision, which we refer to as 'pre-decisional doubt'. When choosing between multiple choice options, people often feel conflicted which option to choose as they are uncertain which choice alternative provides the best utility. The second type of doubt concerns the doubt that emerges *after* having made a decision, but before the outcome is known - we will refer to this as 'post-decisional doubt'. This type of doubt pertains to those instances when people start questioning the correctness of their decision *after* having committed to one of the choice options (but before knowing the actual decision outcome). Although we explore in detail whether the first type of doubt (i.e., pre-decisional doubt) affects the intensity of a person's regret, we primarily elaborate in the introduction on understanding the relationship between post-decisional doubt and regret. This narrow focus stems in part from the following two reasons. First, we tested in several studies whether pre-decisional doubt affects the intensity of regret but find no support for a relationship. We address this (null) finding in depth in the General Discussion. Second, and perhaps more important, doubt is typically experienced when a contradictory argument becomes available that challenges the correctness of one's decisions, beliefs, or opinions. For example, after deciding to trust a person, thoughts may become available (issued by oneself or somebody else) that undermines the correctness of one's decision, rendering a state of doubt. As such, doubt is thus typically experienced *after* having selected a choice option[2] and the results of our first study support this conjecture as decision makers indeed indicated that they experienced more doubt after having made a decision (as opposed to before). In the remainder of the introduction, we therefore focus in more detail on explaining how post-decisional doubt is believed to affect the experience of regret.

2.1. Antecedents of post-decisional doubt.

Although not much is known about the consequences of post-decisional doubt on behavior and emotions, various streams of research might be informative about its antecedents. For example, in the domain of social decision-making, Heath and Gonzalez (1995) found that decision makers who interacted with others prior to reaching a decision felt more certain about the correctness of their decision than those who were unable to consult with others. In the domain of financial decision-making, Estes and Hosseini (1988) established that (1) gender, (2) familiarity with investing in financial markets, (3) college credit hours in accounting and finance, (4) experience in evaluating stocks, and (5) the amount invested were significantly associated with a person's degree of confidence (or lack of doubt) after an investment decision. Finally, in understanding the cognitive mechanisms of decision-making, Kiani, Corthell, and Shadlen (2014) found that a person's degree of decision certainty was significantly correlated with the time a decision maker needed to reach a decision (i.e., longer decision times were associated with lower decision certainty ratings). In sum, prior research in social-, financial-, and cognitive decision making has identified various situational and personal determinants of a person's degree of post-decisional certainty (or lack of doubt). However, while we may know what factors affect a decision-maker's degree of certainty or doubt in one's decision, there is not much insight into its consequences on subsequent behaviors and especially emotions. In what follows, we articulate how different theories of emotions and decision-making may be interpreted to predict how an instance of post-decisional doubt affects the experience of regret.

2.2. Consequences of post-decisional doubt on the experience of regret.

The lack of research attention for the consequences of post-decisional doubt is consistent with the observation that research in decision-making and emotions has primarily focused on two distinct phases in the decision-making process: a *pre-decisional* phase in which the choice options are compared before making a decision, and a *post-outcome* phase in which the consequences of the decision are known (Kirkebøen & Teigen, 2011). However, the intermediate phase (i.e., the time period *between* a decision and the outcome) has largely been ignored even though decisions and the outcomes stemming from these decisions are often separated from each other by a certain time period. For example, a person's decision to invest in the stock market today usually implies she has to wait to find out whether it was a good investment. Even for decisions for which the outcomes are quickly realized (such as playing roulette), choices and outcomes are separated by a brief period of time. Yet, although the intermediate phase is common, research only recently began to explore how events during this period affect a person's emotional reaction to the outcome. For example, Kirkebøen, Vasaasen, & Teigen (2013) recently found that individuals who chose to revise their decision during these time periods (from a correct to a wrong option) regretted their choice more than those who selected the wrong option directly (see also, Kirkebøen & Teigen, 2011; Kruger, Wirtz, & Miller, 2005). Here we argue that even a brief instance of doubt during this period can affect the intensity of a person's regret.

At this point, it might be useful to distinguish more clearly how post-decisional doubt differs from regret as both are experienced after a decision is made. First, there is typically a temporal difference. Specifically, post-decisional doubt is felt after making a decision, but before the outcomes are known. During this phase, decision makers are still uncertain about what the outcome will be (and whether they made a correct decision or not). Regret, on the other hand, is felt when people realize that they made a mistake (Breugelmans et al., 2014; Roseman, Wiest, & Swartz, 1994; Zeelenberg, Van Dijk, & Manstead, 1998). This is typically when the outcomes of both the chosen alternative and the foregone alternative are revealed (e.g., Boles & Messick, 1995; Coricelli et al., 2005; Larrick & Boles, 1995; Ritov, 1996; Ritov & Baron, 1995; Van Dijk & Zeelenberg, 2005; Zeelenberg et al., 1996). Note that it is possible to feel regret in the intermediate phase when decision makers are already convinced that they made a mistake before learning the actual outcome (see Kirkebøen & Teigen, 2011 who refer to this as pre-outcome regret). We address this possibility in depth in Study 3 in which we find that post-decisional doubt affects a person's level of regret above and beyond any feelings of pre-outcome regret.

In order to clarify the difference between post-decisional doubt and regret in more depth, and to ascertain that these differences are not only temporal, but also experiential in nature, we started with a simple two-group pilot-study on Amazon Mechanical Turk[3] (109 males, 92 females; $M_{age} = 35.63$, $SD = 10.27$). More specifically, we asked

[2] We thank an anonymous reviewer for pointing this out.

[3] The use of internet samples has become a common practice in psychological research. Importantly, it has repeatedly been demonstrated that MTurk participants are equally reliable than lab participants while providing greater diversity (e.g., Paolacci & Chandler, 2014; Paolacci, Chandler, & Ipeirotis, 2010).

participants to give a detailed description of a situation in which they either started doubting (N = 101) or regretting (N = 100) a decision they made. After providing this description, participants indicated for various statements how accurately each statement described their respective experience (1 = *Not at all accurate*; 7 = *Very accurate*). These items were intended to pick up the experiential content of the two constructs and examine their discriminant validity (cf., Breugelmans et al., 2014; Roseman et al., 1994).[4] The results (see Table 1) reveal that post-decisional doubt and regret are markedly different experiences. Participants in the post-decisional doubt condition scored significantly higher on (1) repeatedly wondering whether one made the right decision, (2) the unsettling feeling of not knowing for sure, and (3) being driven crazy by the uncertainty. Those in the regret condition, on the other hand, scored significantly higher on (1) feeling a tendency to kick oneself, (2) being clear that they made a mistake, (3) repeatedly blaming themselves for the mistake they made, and (4) wishing for a second chance. The results of this pilot study provides strong support for the conjecture that post-decisional doubt and regret are experienced differently. More specifically, while post-decisional doubt is characterized by feeling uncertain about the correctness of one's decision, regret is defined by knowing for certain that one has made a mistake (offsetting the aversive feeling and behavioral tendencies). Note that none of the participants in the regret condition mentioned the word doubt in their writings, and only 12 out of the 101 in the post-decisional doubt condition used the word regret, [5] providing further support for the difference between these two constructs. In what follows, we build upon these initial findings and examine how doubt during the post-decisional phase can affect the intensity of regret in the post-outcome period when learning that the outcome could have been better.

To understand why and how post-decisional doubt affects the intensity of regret, we advance two competing hypotheses that both follow from the current literature on emotions. The first hypothesis is that the intensity of a person's regret following a poor decision is *attenuated* when the decision was already doubted before the outcome was known. This hypothesis is built upon our interpretation of *subjective expected pleasure theory* (SEP; Mellers, et al., 1999), which extends decision affect theory (Mellers, Schwartz, Ho, & Ritov, 1997) to include regret in addition to disappointment and surprise. SEP integrates ideas from regret and disappointment theories (Bell, 1982; Loomes & Sugden, 1982) to predict the intensity of an emotional response to the outcome of a decision. In SEP, emotional responses to outcomes depend upon (1) the utility of the outcome, (2) how surprising the outcome is, and (3) a disappointment and regret function. The regret function reflects the difference in utility of the obtained outcome and the outcome that could have been obtained had one chosen differently. Crucially for our hypothesis, in the regret function, the "impact of regret depends on the surprisingness of the joint outcome" (Mellers et al., 1999, p. 334). Thus in SEP, unexpected outcomes following a poor decision generate more regret than expected outcomes. In support of this account, research consistently demonstrates that losses indeed evoke more intense emotional reactions when the outcome came as a surprise. For example, McGraw, Mellers and Tetlock (2005) found that Olympic athletes who won silver yet who expected gold felt more disappointed than bronze medalists. In a similar vein, studies by Huang and Zeelenberg (2012) revealed that financial managers who made a poor investment experienced more regret when the loss came as a surprise as opposed to when the loss was expected (see also, Lin, Huang, & Zeelenberg, 2006). Following SEP, already doubting one's decision is therefore predicted to *attenuate* regret as it takes away the element of surprise when learning that the outcome indeed could have been better. That is, when one doubts whether one has made the correct decision or not, more thought is given to the possible different outcomes, which should make these outcomes less surprising. Hence, regret should be *reduced* when a person already doubted one's decision (as compared to a person who is certain that she made the correct decision).

The second, competing, hypothesis about the effect of post-decisional doubt on regret can be derived from *decision justification theory* (DJT; Connolly & Zeelenberg, 2002) and *regret regulation theory* (RRT; Zeelenberg & Pieters, 2007). These theories postulate that justifications and feelings of self-blame affect the intensity of regret. Specifically, it has repeatedly been shown that people experience more regret when they feel responsible for having made a 'wrong' decision (e.g., Inman & Zeelenberg, 2002; Pieters & Zeelenberg, 2005; Zeelenberg et al., 1998). Already doubting one's decision before knowing the outcome can be seen as an indication that one may have made the wrong choice (as compared to those who are certain that they made the right decision). It seems likely that this goes hand in hand with blaming oneself for having made a poor decision when learning the aversive outcome and, consequently, more intense regret.

Taken together, based on the current literature, we can make two opposing predictions about the effect of post-decisional doubt on the experience of regret. Both predications are plausible, firmly based on extant theorizing and consistent with published research findings. Specifically, SEP leads us to expect *attenuated* regret when the decision is already doubted in the post-decision but pre-outcome period. DJT and RRT, on the other hand, leads us to predict the opposite, such that regret would be *amplified* when a decision-maker already doubted whether she has made the correct decision or not.

3. Overview of the present research

We conducted six studies to examine whether the relationship between post-decisional doubt and regret was more consistent with the account provided by SEP or the ones provided by DJT/RRT. As initial start, we ran a second pilot-study in which participants (N = 101; 54 males, 47 females; M_{age} = 32.08, SD = 10.81) were asked to describe a personal experience in which they considered two choice options (A and B), subsequently chose option A but realized over time that option B would have been the better choice. After describing the choice situation in detail, participants were asked (1) whether they ever questioned their decision after reaching their decision (but before knowing the outcome) and (2) whether they ever doubted their decision after their decision (1 = *Never, I was certain I made the right decision*, 5 = *Often*). These two items were averaged into a 'post-decisional doubt' composite measure (r = .80, p < .001; M = 4.09, SD = 0.88). To assess regret, participants were asked the extent that they regretted choosing option A over option B once realizing that B was the better choice (1 = *Not at all*, 5 = *Very much*; M = 4.01, SD = 1.03). Supporting decision justification theory and regret regulation theory, more post-decisional doubt predicted *more* intense feelings of regret, β = .47, t (99) = 5.30, p < .001.[6]

In what follows, we build upon these preliminary findings and extend them in several ways. Using a variety of different contexts and methodologies (autobiographical recall studies, scenario studies and

[4] To ascertain that our measure reflects two underlying factors, we ran a factor analysis with Varimax rotation. The analysis yielded two factors explaining a total of 66.276% of the variance. Inspection of the rotated loading patterns indicated that the items 'I felt a strong urge to kick myself', 'It was very clear I made a mistake', 'I kept blaming myself for the mistake I made', and 'I often wished for a second chance' uniquely loaded on the first factor (labeled 'regret') while 4 items uniquely loaded on the second factor (labeled 'post-decisional doubt').

[5] Note that these participants did not use the words doubt and regret interchangeably in their descriptions. They only mentioned regret in their writings to inform us how they felt after learning the outcome of their decision.

[6] To control for the importance of the decision, we also asked participants how important this decision was to them (1 = *Not at all important*, 5 = *Very important*; M = 3.82, SD = 1.05). Controlling for the importance of the decision did not change the results in any meaningful way.

Table 1
Mean experiential content ratings for the post-decisional doubt and regret conditions (N = 201).

Item	Doubt experience		Regret experience	F (1, 199)	p
I kept wondering whether I made the right decision	5.92 (2.05)	>	4.43 (2.05)	36.32	.001
I felt a strong urge to kick myself	3.94 (2.12)	<	4.90 (1.90)	11.44	.001
Not knowing for sure felt unsettling	5.16 (1.58)	>	3.88 (1.98)	25.70	.001
It was very clear I made a mistake	4.12 (1.98)	<	5.34 (1.76)	21.39	.001
Although I couldn't articulate what it was, something just didn't feel right	4.55 (1.65)	=	4.27 (2.07)	1.17	.27
I kept blaming myself for the mistake I made	3.98 (1.94)	<	5.08 (1.87)	16.77	.001
The uncertainty drove me crazy	4.17 (1.98)	>	3.52 (1.99)	5.37	.02
I often wished for a second chance	4.38 (1.91)	<	5.41 (1.72)	16.24	.001

Note: Entries are mean responses and standard deviations. Participants were asked to indicate the extent that each statement was accurate in describing their respective experience on 7-point scales, with endpoints labeled *Not at all accurate* (1) and *Very accurate* (7).

several behavioral studies and experiments), we consistently find that post-decisional doubts *intensify* regret. We also consistently find no relationship between pre-decisional doubts and regret. Specifically, in Study 1 and Study 2, we tested both the effects of pre-decisional and post-decisional doubt on a person's degree of experienced regret. Both studies revealed that *only* post-decisional doubts increased the intensity of regret while pre-decisional doubts were unrelated. In Study 3–5, we tested the role of post-decisional doubt in actual choice dilemmas (as opposed to remembered- and hypothetical situations). More specifically, in Study 3, participants played a trivia game in which they could earn money for every correct answer they gave, while in Studies 4 and 5, participants' earnings depended upon the choices they made in various social interactions (i.e., a 'trust game' in Study 4 and a 'social prediction game' in Study 5). Importantly, in all studies, some participants made decisions they later regretted. Here we replicated the findings of the previous studies: participants who doubted their decision in the post-decisional phase experienced more intense regret when learning the negative outcome than those who were certain they made the correct decision. Finally, in Study 6, we tested the strength of the relationship between post-decisional doubt and regret by replicating its influence in one of the most robust findings in the domain of regret; the action effect (Kahneman & Tversky, 1982). Reversing the classic action effect, we found that those who started doubting their inaction experienced more regret than those who never doubted their decision to act for a minute. In all studies, we predetermined the sample size, report all dependent measures and experimental conditions, and exclude no participants unless stated otherwise. All study materials and datasets can be retrieved from the Open Science Framework[7] and we encourage readers to consult these for a full understanding of the results.

4. Studies 1 and 2: Two types of doubt and the experience of regret

The second pilot study in the introduction demonstrated that doubts arising *after* a decision are associated with the intensity of a person's regret. In Studies 1 and 2, we extend these findings by testing how regret is affected by doubts that frequently arise *before* reaching a decision. Specifically, people often feel conflicted which option to choose before choosing one of the choice alternatives. How are these pre-decisional doubts related to post-decisional doubts? Importantly, how are both types of doubts related in producing regret? We address these questions in the following two studies.

4.1. Study 1: Autobiographical recall

The procedure of this study was similar to the procedure of our second pilot study in the introduction. One hundred and thirteen workers on MTurk (47 females, 66 males, M_{age} = 33.68, SD = 9.06) were asked to describe a personal choice situation in which they considered two choice options (A and B), they chose option A but realized over time that option B would have been the better choice. After describing the situation in detail, participants were asked a set of questions. To assess *pre-decisional doubt*, participants indicated (1) the extent that they doubted between both options before reaching their decision and (2) the extent that they felt indecisive before reaching their decision (1 = *Not at all*, 5 = *Very much*). These two items were averaged into a 'pre-decisional' doubt composite measure (r = .64, p < .001; M = 3.30, SD = 0.99). To assess *post-decisional doubt*, participants indicated (1) whether they ever questioned their decision after choosing option A and (2) whether they ever doubted their decision after choosing option A (1 = *Never, I was certain I made the right decision*, 5 = *Often*). These two items were averaged into a 'post-decisional' doubt composite measure (r = .85, p < .001; M = 4.13, SD = 0.96).[8] To assess *regret*, participants indicated the extent they regretted choosing option A over option B once realizing that B was the better choice (1 = *Never*, 5 = *Very much*; M = 4.22, SD = 0.94). Finally, participants indicated how important this decision was to them (1 = *Not at all important*, 5 = *Very important*; M = 3.75, SD = 1.13).

4.1.1. Results

First, people indicated experiencing significantly more doubt *after* a decision than *before* making a choice (M = 4.13, SD = 0.96 vs. M = 3.30, SD = 0.99), paired t = 7.10, p < .001. In addition, both types of doubt were significantly (yet not strongly) correlated, r = .18, p = .05. More doubt *before* a decision was thus associated with more doubt *after* one's decision.

Next, in estimating the intensity of a person's regret, we ran a regression analyses with pre-decisional doubt, post-decisional doubt, and importance as predictors in the model. The results indicated that regret was significantly predicted by (1) the importance of the decision and (2) a person's degree of post-decisional doubt. Specifically, important decisions were regretted more than less important decisions, β = .23, t = 2.22, p = .009, and replicating the finding of our second pilot study, more doubt *after* one's decision resulted in more intense feelings of regret, β = .30, t = 3.38, p < .001. The degree of doubt *before* reaching a decision did not have a significant effect on the intensity of a person's regret, β = .14, t = 1.60, p = .11. To gain more insights into the relationship between the two types of doubt and regret, we manipulated both types in Study 2, rather than measuring them as in Study 1.

[7] https://osf.io/ntcy4/.

[8] To verify that our measure reflects two underlying factors (i.e., pre-decisional and post-decisional doubt respectively), we ran a factor analysis with Varimax rotation. The analysis yielded two factors explaining a total of 87.24% of the variance. Inspection of the rotated loading patterns indicated that the items intended to measure post-decisional doubt uniquely loaded on the first factor while the items intended to measure pre-decisional doubt uniquely loaded on the second factor.

4.2. Study 2: Experimental manipulation of pre- and post-decisional doubt

Four hundred and three online participants (159 females, 244 males, M_{age} = 33.89, SD = 9.86) were randomly assigned to one of four conditions based on a 2 (Doubt *before* the decision: Yes vs. No) × 2 (Doubt *after* the decision: Yes vs. No) between-subjects design. Participants read a scenario in which they had to decide which of two hotels to book. The different manipulations of doubt *before* the decision are in [brackets] and the different manipulations of the degree of doubt *after* the decision are in {braces}.

> You planned a business trip to India and had to decide which hotel to book. There were two hotels that you took into consideration: The New Delhi hotel and The Bombay hotel. [You decided, without any hesitation, to book a room at The New Delhi/You doubted what to do but eventually decided to book a room at The New Delhi]. {and you have never questioned your decision for a minute ever since/yet you started doubting whether you made the right decision afterwards}. Today, you learn that The New Delhi is not that great while The Bombay is quite comfortable.

After reading the scenario, participants were asked to indicate how much regret they would feel about deciding to book a room at The New Delhi (1 = *Not at all*, 7 = *Very much*).

4.2.1. Results

The means and standard deviations are presented in Table 2. Replicating the findings of Study 1, the results only showed a significant main effect for 'post-decisional doubt' on regret ratings, F (1, 399) = 10.33, p = .001, η^2 = .03, while no effect of pre-decisional doubt was found, F (1, 399) = 3.18, p = .08, η^2 = .008, neither a significant interaction, F (1, 399) = 1.39, p = .24, η^2 = .003. Participants thus indicated that they would experience most regret when they started doubting their decision, irrespective of the degree of doubt that they experienced before choosing one of the choice options. Overall, the results of our first two studies indicate that post-decisional doubt intensifies the experience of regret while pre-decisional doubts are unrelated. Because pre-decisional doubts do not appear to influence the intensity of a person's regret, we only focus on the role of post-decisional doubt in our next studies. Specifically, in Study 3–5, we tested the role of post-decisional doubt in actual choice dilemmas (as opposed to remembered- and hypothetical situations).

5. Study 3: Post-decisional doubt in an incentivized trivia game

The current study provides three extensions. First, we test how post-decisional doubt affects regret in an actual choice dilemma (i.e., participants played a trivia game in which they could earn money), allowing us to assess a participant's degree of post-decisional doubt at exactly the right moment (i.e., directly *after* a decision yet *before* the outcome is known). Second, because participants can answer trivia questions incorrectly and correctly, we asses regret in the first place, and relief in the second. Relief is the emotion that people experience when realizing that their current situation could have been worse if they had decided differently (Zeelenberg, 2009). Although not our primary interest, we explore in detail whether and how relief is related to post-decisional doubts. Finally, while regret is typically experienced after knowing the outcome of a decision, recent research by Kirkebøen and Teigen (2011) indicates that it is also possible to experience regret *before* the outcome is revealed (i.e., during the same phase as to when the experience of post-decisional occurs). Kirkebøen and Teigen refer to this as pre-outcome regret. For example, in one of their studies, participants imagined agreeing to give a speech at a future wedding and were asked how much they would regret this decision (before giving the actual speech). The results showed that this decision would already be regretted, even though the outcome of the public performance was still unknown. Given that pre-outcome regret and post-decisional doubt can co-occur in the same decisional phase, it is possible that instead of post-decisional doubt, we are merely picking up on the effects caused by pre-outcome regret. This is why, in the current study, we assessed a person's degree of (1) pre-outcome regret and (2) post-decisional doubt after one's decision (but before knowing the outcome). This allows us a very conservative test: does post-decisional doubt increases a person's degree of regret after learning the outcome above and beyond any feelings of pre-outcome regret? Note that this study's pre-registration can be found at https://aspredicted.org/pv6mn.pdf.

Table 2
Effect of pre-decisional and post-decisional doubt on regret, Study 2 (N = 403).

	Post-decisional Doubt		
	Yes	No	
Pre-decisional doubt			
Yes	5.39 (1.19)	4.80 (1.53)	5.10 (1.38)
No	5.47 (1.16)	5.20 (1.51)	5.33 (1.37)
	5.43 (1.17)	5.00 (1.53)	

Note: Entries are mean regret ratings (standard deviations in parentheses), assessed on a 7-point scale, with higher scores indicating more intense regret.

5.1. Method

5.1.1. Participants and procedure

Four hundred and four participants on MTurk played a fully incentivized, general knowledge quiz. Prior to analyses (and following the pre-registration plan), we discarded the response of one participant for failing an attention check. In addition, the data of fourteen participants were missing due to the imposed time restriction when answering the general knowledge question (see below for more details), leaving us with a final sample of 389 participants (183 females, 206 males, M_{age} = 37.00, SD = 11.04). All participants received $0.25 as fixed fee with the potential to earn an extra bonus payment (dependent on their answer in the quiz). Specifically, participants learned that they would be asked a general knowledge question and that they could earn $0.25 extra when their answer was correct. After reading the instructions, participants were redirected to the trivia question (i.e., what is the capital city of Brazil? São Paulo, Rio de Janeiro, or Brasília?). To ensure that participants would not look up the correct answer, they were instructed to answer the question within 15 s (or lose the opportunity to answer the question) and we programmed the study as such that it would auto-advance after a certain time frame.

5.1.2. Measurements

After answering the question (but before informing a participant whether it was correct or not), we assessed this person's degree of (1) pre-outcome regret and (2) post-decisional doubt. To measure these two factors, participants were presented with four statements (in random order) and were asked how accurate each statement was in describing how they felt about their answer (1 = *Not at all accurate*; 5 = *Very accurate*). We used the first four statement from pilot study 1 (see Table 1) to measure these constructs as these items capture the important experiential distinction between both experiences. That is, while doubt is characterized by feeling uncertain about the correctness of one's decision, regret is defined by knowing for certain that one has made a mistake (a belief that can already present itself before knowing the actual outcome in the case of pre-outcome regret; see Kirkebøen & Teigen, 2011). As such, to measure pre-outcome regret, participants responded to the statements: "At this moment, I feel a strong urge to kick myself for the clear mistake I made" and "At this moment, it is

already very clear to me that I made a mistake", $r = .77$, $p < .001$.[9] To measure post-decisional doubt, participants responded to the statements: "I am wondering if I made the correct decision" and "Not knowing for sure if my answer is correct or not feels unsettling", $r = .65$, $p < .001$.

To ascertain that these items indeed measure pre-outcome regret and post-decisional doubt (and not one underlying factor), we ran a principal component analysis with Varimax rotation. The analysis yielded two factors explaining a total of 86.087% of the variance (see Table 3). Inspection of the rotated loading patterns showed that the items intended to measure 'pre-outcome regret' loaded high on the first factor and low on the second factor while the reverse was true for those items intended to measure 'post-decisional doubt'. These results indicate that two underlying factors (as opposed to one general factor) are reflected in our measurement instrument. As such, we created composite scores for each factor by averaging the corresponding items into composite measures.

After participants indicated their degree of pre-outcome regret and post-decisional doubt, we redirected them to a new screen in which they learned whether their answer was incorrect or correct. When incorrect (correct), participants were asked to indicate how much they regretted (felt relieved for) having answered the question with their respective answer (1 = *Not at all*, 5 = *Very much*).

5.2. Results and discussion

In total, 262 participants answered the question incorrectly (127 answered correctly). We were interested in how the intensity of a person's regret and relief was related to the degree that they regretted and doubted their answer before knowing the outcome of the quiz.

5.2.1. Regret

Table 4 (upper panel) reports the means, standard deviations, and correlations of all study variables for participants who experienced regret. In testing the roles of pre-outcome regret and post-decisional doubt on regret, a two-stage hierarchical multiple regression analysis was conducted. At stage 1, we conducted a multiple regression estimating regret with gender, age, and pre-outcome regret. Critically, at stage 2, post-decisional doubt was entered as predictor into the model to test whether adding doubt would significantly explain more unique variance.

The regression statistics for regret are presented in the upper panel of Table 5. At stage 1, more regret *before* knowing the outcome (i.e., pre-outcome regret) was significantly related to more regret *after* learning the outcome of one's decision. We also found that gender was related to regret (women evidently experienced more regret than men when learning the aversive outcome). Importantly, at stage 2, including post-decisional doubt significantly improved the model ($\Delta R^2 = .08$; $p < .001$). Replicating our previous findings, more doubt before knowing the outcome produced significantly more regret after learning the outcome. These findings are important for several reasons. First, we replicate the effect of doubt on regret in a fully incentivized choice dilemma in which doubt was assessed at exactly the right moment (i.e., *after* one's decision, but *before* knowing the outcome). Second, this effect exists above and beyond any feelings of regret that a person may already experience about one's decision. That is, given that pre-

[9] Please note that one reviewer felt that the statements assessing pre-outcome regret were not entirely appropriate, since they seemed to imply the existence of a mistake in addition to reporting feelings. Although we understand this concern, we believe that these statements do reflect the experience of pre-outcome regret correctly as they measure two defining features of regret: (i) knowing for certain that one has made a mistake (a belief that can already present itself before the actual outcome is revealed; see Kirkebøen & Teigen, 2011) and (ii) the urge to punish oneself as a result of one's mistake (e.g., Zeelenberg et al., 1998).

Table 3
Rotated factor loadings, Study 3 ($N = 389$).

	Loadings	
Items	Factor 1 Pre-outcome regret	Factor 2 Post-decisional doubt
At this moment, I feel a strong urge to kick myself for the clear mistake I made	**.919**	.199
At this moment, it is very clear to me that I made a mistake	**.922**	.174
I am wondering if I made the correct decision	.082	**.926**
Not knowing for sure if my answer is correct or not feels unsettling	.322	**.843**
Eigenvalue	2.418	1.026
% of total variance	60.45%	25.64%
Total variance		86.09%

Table 4
Means, standard deviations, and correlations, Study 3 (upper panel regret, $N = 262$; lower panel relief, $N = 127$).

Variables	Mean	*SD*	1	2	3	4	5
Age	36.91	10.88	1				
Gender	–	–	−.03	1			
Pre-outcome regret	2.02	1.09	−.01	.06	1		
Post-decisional doubt	3.37	1.14	.02	.26***	.28***	1	
Regret	3.74	1.41	.03	.17**	.19**	.34***	1
Variables	Mean	*SD*	1	2	3	4	5
Age	37.19	11.41	1				
Gender	–	–	.09	1			
Pre-outcome regret	1.57	0.92	−.13	.09	1		
Post-decisional doubt	2.48	1.34	−.11	.20*	.58***	1	
Relief	3.69	1.28	−.11	.30**	.34***	.55***	1

*$p < .05$, **$p < .01$, ***$p < .001$.

Table 5
Summary of the hierarchical multiple regression analyses for variables predicting regret and relief in a trivia game, Study 3 (total $N = 389$).

	Regret ($N = 262$)					
	Stage 1			Stage 2		
Variables	*b*	*SE b*	β	*b*	*SE b*	β
Age	0.01	0.01	.04	0.00	0.01	.03
Gender (0 = Male, 1 = Female)	0.44	0.17	.15*	0.23	0.17	.08
Pre-outcome regret	0.23	0.08	.17**	0.12	0.08	.09
Post-decisional doubt				0.36	0.07	.30***
R^2			.05			.13
F for change in R^2	5.23**			22.17***		
	Relief ($N = 127$)					
	Stage 1			Stage 2		
Variables	*b*	*SE b*	β	*b*	*SE b*	β
Age	−0.01	0.01	−.10	−0.01	0.01	−0.07
Gender (0 = Male, 1 = Female)	0.75	0.22	.28**	0.55	0.20	.20**
Pre-outcome regret	0.42	0.11	.31***	0.05	0.12	.04
Post-decisional doubt				0.46	0.09	.49***
R^2			.20			.35
F for change in R^2	10.11***			28.37***		

*$p < .05$, **$p < .01$, ***$p < .001$.

outcome regret and post-decisional doubt can co-occur, it could be possible that we are merely picking up on the effect of pre-outcome regret when testing our hypotheses. The results of the current study exclude this possibility and provide strong support for the unique impact of post-decisional doubt on the experience of regret.[10]

5.2.2. Relief

Although our main interest is in the effect of doubt on regret, we also explored whether post-decisional doubt would impact the intensity of a person's relief. Table 4 (lower panel) reports the means, standard deviations, and correlations of all study variables for participants who experienced relief. In testing this relationship, we again conducted a two-stage hierarchical multiple regression analysis. At stage 1, we ran a multiple regression estimating relief with a person's gender, age, and pre-outcome regret. At stage 2, post-decisional doubt was entered as predictor into the model.

The regression statistics for relief are presented in the lower panel of Table 5. At stage 1, more regret *before* knowing the outcome (i.e., pre-outcome regret) was significantly associated with more relief *after* learning the outcome. We also found that gender was related to relief as women evidently experienced more relief than men. Importantly, at stage 2, including post-decisional doubt significantly improved the model ($\Delta R^2 = .15$; $p < .001$). Similar to the effect on regret, doubting one's decision before knowing the outcome produced more relief after learning that one's decision was correct. Overall, these findings support and extend the finding that post-decisional doubt increases the intensity of a person's emotional reaction to outcomes. In our next study, we tested the role of post-decisional doubt in a very different choice context; the decision to trust others or not.

6. Study 4: Post-decisional doubt in an incentivized trust game

In our next study, the effect of post-decisional doubt on regret was tested in a fully incentivized social choice dilemma; the trust game. The trust game (Berg, Dickhaut, & McCabe, 1995; Dasgupta, 1988) is a common experimental paradigm for studying mutual trust in two-person interactions. The trust game, as depicted in Fig. 1, is an anonymous one-shot interaction in which people in the role of Player 1 (the trustor) have to decide between two possible actions: if Player 1 does not trust Player 2 (and moves OUT), the game ends, leaving both parties with moderate rewards. If Player 1 does trust (and moves IN), Player 2 has to choose between two possible options: honoring trust by moving left, leaving both persons better off than when Player 1 did not trust, or betraying trust (by moving right), which maximizes personal gain for Player 2 at the expense of Player 1.

As a trustor in the trust game, there are thus two regret evoking choices. First, trusting a trustee who turns out to be untrustworthy (i.e., choosing IN while Player 2 chooses RIGHT). Second, not trusting a trustworthy person (i.e., choosing OUT while Player 2 chooses LEFT). These choices are regret evoking as they yield outcomes that could have been better had Player 1 chosen differently (see also, Martinez & Zeelenberg, 2015). In the current study, we were interested in how much regret players would feel in both situations and how this is related to the degree that they already doubted their decision prior to knowing the decision of the trustee.

[10] In Appendix A, we present the results of a (preregistered) exploratory analysis, testing whether the effect of post-decisional doubt on regret is different for participants whose answer was a complete random guess (versus a more informed decision). Interestingly, the results indicated that randomly choosing a choice alternative induced doubt, yet this did not feed into the experience of regret when learning the poor outcome. These results suggest that doubt originating from different sources impacts the intensity of regret differently.

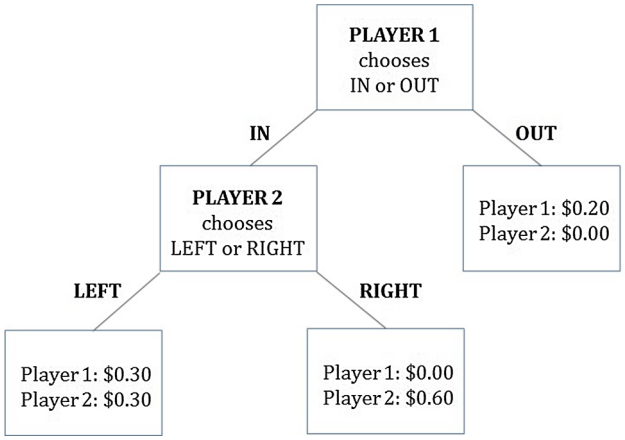

Fig. 1. Simple trust game as used in Study 4.

6.1. Method

Three hundred and six participants on MTurk played a fully incentivized, anonymous trust game in the role of Player 1 (trustor) or Player 2 (trustee). All participants received $0.30 as show-up fee and earned an extra bonus (dependent on the choices that both players made during the game).

Using a chart as in Fig. 1, participants received instructions regarding the rules of the anonymous two-person interaction. There were two stages. First, 153 participants in the role of Player 1 chose to trust or not trust player 2. These are the participants that are included in the analysis (65 females, 88 males, $M_{age} = 34.08$, $SD = 10.26$). In addition, there were also 153 participants in the role of Player 2 who chose to honor trust or not. The responses of these participants were collected to create a real trust game for participants in the role of Player 1, but will not be analyzed as we did not measure any emotional reactions of these players. We only collected their decisions (honor trust vs. betray trust) so we could randomly couple them to Player 1 and inform Player 1 about the decision of their respective partner.

This procedure resulted in two *regret situations* for participant in the role of Player 1: 42 couples in which Player 1 chose to trust while Player 2 chose to betray trust, and 43 couples in which Player 1 chose not to trust, but found out that Player 2 would have honored the trust. There were also two *relief situations* for participants in the role of Player 1: 35 couples in which Player 1 chose to trust and Player 2 honored the trust, and 33 couples in which Player 1 chose not to trust and found out that Player 2 indeed would have betrayed one's trust. We assessed Player 1's emotional reaction to Player 2's decision and examined how this reaction was related to Player 1's degree of post-decisional doubt.

6.2. Measurements

6.2.1. Post-decisional doubt

After Player 1's decision to trust or not (but before knowing the decision of Player 2), we assessed this person's degree of post-decisional doubt. Specifically, participants in the role of Player 1 indicated (1) how confident they were that their decision to go IN or OUT (depending on their decision) was the best decision, (2) how certain they were that their decision to go IN or OUT was the best decision, and (3) the extent they doubted whether their decision to either go IN or OUT was the best decision (1 = *Not at all*, 5 = *Very much*). The first two items were reversed coded and the three items were subsequently averaged into a 'post-decisional doubt' composite measurement ($\alpha = .88$). Next, participants were redirected to a new screen in which they were informed about the decision of their partner (Player 2).

Table 6
Means, standard deviations, and correlations, Study 4 (upper panel regret, $N = 85$; lower panel relief, $N = 68$).

Variables	Mean	*SD*	1	2	3	4	5	6
Age	34.25	10.30	1					
Gender	–	–	−.01	1				
Decision	–	–	−.08	−.20	1			
Post-doubt	2.57	1.06	−.03	.11	−.19	1		
Self-blame	2.80	1.70	.03	.06	−.23*	.29**	1	
Regret	2.95	1.70	.02	.08	−.40***	.39***	.82***	1
Variables	Mean	*SD*	1	2	3	4	5	6
Age	33.88	10.30	1					
Gender	–	–	.19	1				
Decision	–	–	.02	−.06	1			
Post-doubt	2.37	1.00	−.12	−.12	−.33**	1		
Self-praise	3.84	1.17	−.12	−.11	.01	.01	1	
Relief	4.37	1.05	−.07	.01	−.15	.07	.60***	1

*$p < .05$, **$p < .01$, ***$p < .001$.

6.2.2. Regret and blame

All participants who made a 'wrong' decision (i.e., those who decided to trust an untrustworthy party and those who decided not to trust a trustworthy party) were asked to indicate, (1) the degree that they blamed themselves for having made a poor decision, and (2) the degree that they regretted their decision (1 = *Not at all*, 5 = *Very much*).

6.2.3. Relief and praise

All participants who made a 'correct' decision (i.e., those who decided to trust a trustworthy party and those who decided not to trust an untrustworthy party) were asked to indicate, (1) the degree that they praised themselves for having made a good decision, and (2) the degree that they felt relieved for having made a good decision (1 = *Not at all*, 5 = *Very much*).

6.3. Results

6.3.1. Regret

Table 6 (upper panel) reports the means, standard deviations, and correlations of all study variables for participants who made a wrong decision. In testing the role of post-decisional doubt on the experience of regret, a two-stage hierarchical multiple regression analysis was conducted. At stage 1, we conducted a multiple regression estimating regret with Player 1's age, gender, decision (0 = trust and 1 = not trust) and degree of post-decisional doubt as predictors. At stage 2, the interaction of decision and post-decisional doubt was entered as predictor in the model.

The regression statistics for regret are presented in the upper-left panel of Table 7. The results showed that players who chose to trust (and got betrayed) experienced significantly more regret than those who chose not to trust a trustworthy party. This finding is consistent with the notion that 'trust betrayal' is one of the most painful social experiences (Bohnet, Greig, Herrmann, & Zeckhauser, 2008). Importantly, replicating our previous findings (now in a social dilemma), more post-decisional doubt after one's decision was again associated with more intense levels of regret when learning the aversive decision outcome.

Interestingly, in the second stage, we observed that the relationship between post-decisional doubt and regret was moderated by the decision of a player (trust vs. not trust). Specifically, although post-decisional doubt predicted more intense regret for those players who chose not to trust a trustworthy partner, $b = 0.94$, $SE = 0.19$, $p < .001$, this relationship was absent for players who chose to trust and got betrayed, $b = 0.23$, $SE = 0.24$, $p = .33$. As can be seen in Fig. 2, players who chose to trust (and got betrayed) regretted their choice irrespective of whether they doubted their decision prior to knowing the outcome of the social interaction. However, for those who chose not to trust a trustworthy partner, more post-decisional doubt was again associated with more intense regret.

6.3.2. Self-blame

To estimate levels of self-blame, we again conducted a two-stage hierarchical multiple regression analysis with age, gender, decision type and post-decisional doubt as predictors in stage 1. The regression statistics for self-blame are presented in the upper-right panel of Table 7. In stage 1, we did not find an effect of decision type (0 = trust and 1 = not trust) on perceptions of self-blame. Players who chose to trust an untrustworthy partner thus experienced similar degrees of blame than those who chose not to trust a trustworthy partner. We did find that post-decisional doubt was significantly related to perceptions of self-blame. Players who started doubting their decision were thus significantly more likely to blame themselves for having made a poor decision. In stage 2, we included the interaction of a person's decision and post-decisional doubt but we did not observe a significant interaction effect.

6.3.3. Relief and praise

Table 6 (lower panel) reports the means, standard deviations, and correlations of all study variables for participants who made a correct decision. We explored whether we again would find that post-decisional doubt influences feelings of relief, but we did not find any significant relationships in this study (see lower-left panel of Table 7). In a similar vein, we did not find any significant relationship between post-decisional doubts and feelings of praise (lower-right panel). The exact reason why we find mixed results for the role of post-decisional doubt in the experience of relief is unclear. In Study 3, where we examined choices in a trivia quiz, post-decisional doubt and relief were related, but in the present situations it seems like the relief that our participants experienced only reflected the valence of the outcome. Because in trust games, the outcomes always depend on the choices of the other player, individual considerations of doubt might not be that important when realizing that one has made the correct decision. To gain more insights into the relationship between post-decisional doubt and regret in actual choice dilemmas, we manipulated doubt in Study 5, rather than measuring it as in Studies 3 and 4.

7. Study 5: Manipulating post-decisional doubt in an incentivized choice dilemma

7.1. Method

7.1.1. Participants and procedure

Three hundred and one participants on MTurk (127 females, 174 males, $M_{age} = 35.93$, $SD = 10.47$) played a 'color game' in which participants were asked to predict the favorite color of another participant who participated earlier in the study. More specifically, participants were told that they were randomly coupled with a male participant named John (in reality a fictional player) who was asked to indicate which color he favors more, blue or yellow. It was the participant's task to predict the color that the other player picked. If the prediction was correct, the participant would receive $0.20 as bonus payment, while John would receive nothing. However, when incorrect, the participant would receive nothing, while John would receive the extra bonus payment.

To manipulate doubt in one's prediction, participants were randomly assigned to one of two experimental conditions. In the first condition (the 'naïve player' condition), participants were told that the other player was not informed about the specific rules concerning the bonus payments. John was thus simply asked to indicate his favorite color (blue or yellow). In the second condition (the 'strategic player' condition), participants were told that the other player was explicitly

Table 7
Summary of the hierarchical multiple regression analyses for variables predicting regret, blame, relief, and self-praise, Study 4.

	Regret						Self-Blame					
	Stage 1			Stage 2			Stage 1			Stage 2		
Variables	*b*	*SE b*	β	*b*	*SE b*	β	*b*	*SE b*	β	*b*	*SE b*	β
Age	0.00	0.02	−.01	−0.01	0.02	−.04	0.00	0.02	.02	0.00	0.02	.07
Gender	−0.06	0.34	−.02	−0.13	0.33	−.04	−0.02	0.37	−.01	−0.10	0.37	−.02
Decision (0 = Trust, 1 = Not trust)	−1.14	0.34	−.34***	−3.04	0.89	−.90***	−0.60	0.37	−.18	−1.73	1.00	−.51
Post-decisional doubt	0.52	0.16	.33**	0.22	0.20	.14	0.41	0.18	.26*	0.23	0.23	.15
Decision × post-decisional doubt				0.74	0.32	.59*				0.44	0.36	.35
R^2			.26			.31			.12			.13
F for change in R^2	6.87***			5.25*			2.56*			1.47		

	Relief						Self-Praise					
	Stage 1			Stage 2			Stage 1			Stage 2		
Variables	*b*	*SE b*	β	*b*	*SE b*	β	*b*	*SE b*	β	*b*	*SE b*	β
Age	−0.01	0.01	−.12	−0.01	0.01	−.12	−0.02	0.01	−.15	−0.02	0.01	−.16
Gender	−0.03	0.25	−.02	−0.01	0.26	−.01	−0.27	0.29	−.12	−0.22	0.29	−.10
Decision (0 = Trust, 1 = Not trust)	−0.18	0.26	−.10	0.04	0.68	.02	0.11	0.29	.05	0.77	0.77	.35
Post-decisional doubt	0.02	0.13	.03	0.06	0.17	.07	0.00	0.15	.00	0.12	0.20	.10
Decision × post-decisional doubt				−0.10	0.27	−.12				−0.29	0.31	−.31
R^2			.03			.03			.05			.06
F for change in R^2	0.43			0.13			0.75			0.89		

*$p < .05$, **$p < .01$, ***$p < .001$.

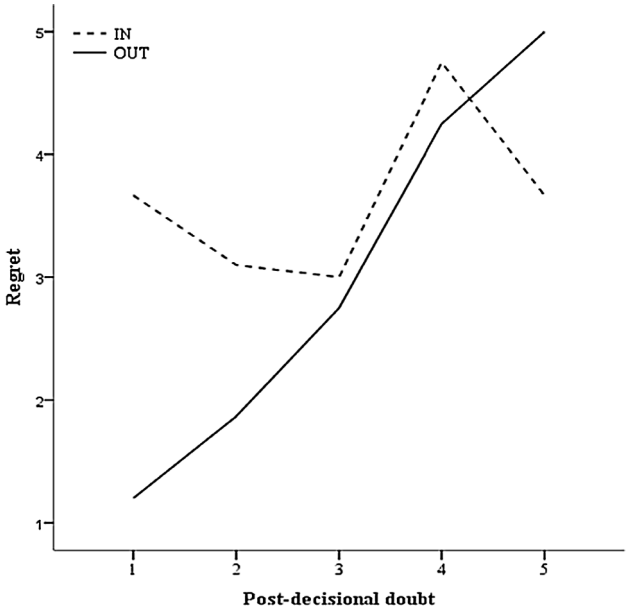

Fig. 2. Regret (mean) as a function of post-decisional doubt and decision type (IN = Trust vs. OUT = Not trust), Study 4.

informed about the rules concerning the bonus payments. When picking a color, John was thus motivated to strategically choose a color that the other player would predict incorrectly. We expected that participants in this condition would therefore experience significantly more doubts about one's prediction (as compared to the first experimental condition in which John was simply asked to pick his favorite color). In a similar vein, given the expected difference in post-decisional doubt as a function of our experimental manipulation, we also expected more regret in the second condition when a participant learned that one's choice was incorrect.

After reading the instructions, participants answered three comprehension checks. Given the simplicity of the 'color game', a large majority (90% or 271 out of 301 participants) answered all comprehension checks correctly. We report the results of all participants below (including those who failed the comprehension checks). Removing these participants did not yield any meaningful differences in the results.[11]

7.1.2. Measurements

After reading the instructions, participants were first asked to predict the color that John chose, blue or yellow. Next, after predicting John's color (yet before informing a participant whether it was correct or not), we assessed a participant's degree of doubt in one's prediction. Specifically, participants indicated the degree that they experienced any doubts about their decision (1 = *Not at all*, 9 = *Very much*).

After indicating the degree of doubt in their respective prediction, participants were redirected to a new screen in which they learned whether their decision was correct or not. We programmed the experiment as such that a participant's prediction was always incorrect. Thus, when a participant's prediction was blue, we told that the other player picked yellow and vice versa. After learning that their prediction was incorrect, participants were asked to indicate the extent that they regretted their decision (1 = *Not at all*, 9 = *Very much*).

7.2. Results

7.2.1. Manipulation check

The manipulation of post-decisional doubt was successful. Participants experienced significantly more post-decisional doubt ($M = 5.73$, $SD = 2.27$) when playing with a 'strategic' player as compared to playing with a player who simply indicated his favorite color ($M = 5.07$, $SD = 2.05$), t (299) = 2.61, $p = .01$. We also found a significant difference in the predictions that participants made. In the condition in which John was simply asked to pick a color, a large majority (89%, or 132/148 participants) thought he picked blue. But, when playing with the strategic player, only a small majority (55%, or

[11] A significant main effect between conditions on the intensity of regret, F (1, 267) = 4.45, $p = .04$, $\eta^2 = .02$.

84/153 participants) predicted he picked blue, χ^2 (1, N = 301) = 43.64, p < .001, φ = .38. In order to rule out that the expected difference in regret between conditions is due to the observed difference in predictions (and not due to the change in post-decisional doubt between conditions), we controlled for this in further analyses.

7.2.2. Regret

An ANOVA revealed a significant main effect between conditions on the intensity of regret, F (1, 297) = 5.64, p = .02, η^2 = .02. As predicted, participants in the 'strategic player' condition experienced more regret (M = 6.26, SD = 2.85) than those who were partnered with a player who was simply asked to pick a color (M = 5.75, SD = 2.82). We did not find a main effect on the different types of predictions that people made (blue vs. yellow), F (1, 297) = 1.63, p = .20, η^2 = .005, neither a significant interaction, F (1, 297) = 3.08, p = .08, η^2 = .01. Overall, this study, in which we manipulated a person's degree of post-decisional doubt, again supported the conjecture that this type of doubt increases the intensity of regret when realizing that the outcome could have been better when chosen differently. In our final study, we examined the role of post-decisional doubt in one of the most replicated findings in the domain of regret: the action effect.

8. Study 6: Post-decisional doubt and the action effect

The action effect refers to the observation that outcomes through action produce more regret than identical outcomes achieved through inaction. In the first study documenting this effect, Kahneman and Tversky (1982; p. 173) asked participants to read a scenario describing two stockowners. One of these, Paul, owned shares in company A, considered switching to stock in company B, but decided against it. Then, after a while Paul found out that he would have earned $1200 if he had switched. The other stockowner, George, owned shares in company B and switched to stock in company A. After a while he realized that he would have earned $1200 if he had decided not switch. Participants were then asked who they thought would experience more regret, Paul (who lost out on $1200 by not switching) or George (who lost out on $1200 by switching)? Although both Paul and George suffered the same financial loss, a large majority of participants believed that George (who switched) regretted his choice more than Paul (who did not switch). Importantly, this effect has been observed in a variety of choice situations (e.g., Landman, 1987; Zeelenberg, Van den Bos, Van Dijk, & Pieters, 2002) and has even been labeled "the clearest and most frequently replicated finding" in the domain of regret (Gilovich & Medvec, 1995, p. 380). Would the effect of post-decisional doubt also emerge in this situation? In three different scenarios we examined whether the action effect reverses when actions are followed with confidence while inactions with considerable levels of doubt. For brevity only the first scenario is described fully. Complete descriptions of the other two scenarios are provided in Appendix B.

8.1. Method

All three scenarios described a situation of two persons who suffered an identical loss either through action or inaction. Participants were subsequently asked who they thought would experience more regret. In the first scenario, participants read the earlier described Kahneman and Tversky scenario and were randomly assigned to one of three conditions; *control*, *doubt-action*, or *doubt-inaction*. Participants in the *control* condition read the original investor scenario in which Paul decided not to switch while George decided to switch and both end up losing $1200. In the *doubt-action* condition participants read an adjusted version of the original scenario in which we mentioned that Paul (who did not switch) never doubted his decision for a minute while George (who switched) started doubting his decision. Finally, in the *doubt-inaction* condition, participants read that Paul (who did not switch) started to doubt his decision while George (who switched) never doubted his decision for a minute. The exact scenario in the doubt-inaction condition read as follows:

> Paul owns shares in company A. During the past year he considered switching to stock in company B. Paul decided against it yet he started questioning whether he made the right decision. Today he finds out that he would have been better off by $1200 if he had switched to the stock of company B. George owned shares in company B. During the past year he considered switching to stock in company A. George decided to switch and never questioned his decision for a minute. Today he finds out that he would have been better off by $1,200 if he had kept his stock in company B.

After reading the scenario, participants were asked to indicate who experienced more regret. The other two scenarios shared the same basic structure and dependent variable (see Appendix B). Participants in all scenario were recruited using MTurk (Scenario 1 N = 149, 59 females, 90 males, M_{age} = 32.56, SD = 10.10; Scenario 2 N = 155, 7 females, 93 males, 5 missing, M_{age} = 33.79, SD = 10.79; Scenario 3 N = 150, 58 females, 87 males, 5 missing, M_{age} = 31.11, SD = 9.59).

8.2. Results and discussion

The results are depicted in Fig. 3 (for the three different scenarios).

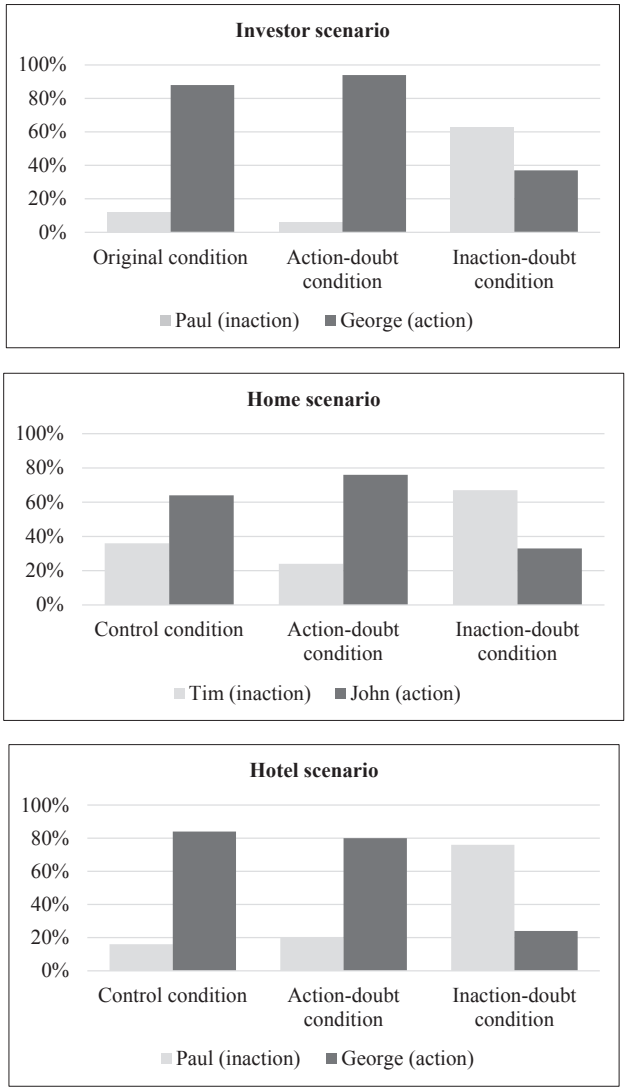

Fig. 3. Proportion of participants indicating who regretted the decision more in the three different conditions of the three scenarios, Study 6.

In order to analyze the data, we collapsed the data of all three scenarios as we did not find any significant differences across the patterns of the three different scenarios. Replicating the action effect, participants in the *control conditions* attributed more regret to the person who decided to act (113 out of 145 or 78%) as compared to the person who decided not to act (32 out of 145 or 22%). The same pattern of results was found in the *action-doubt conditions*: the majority believed that actions followed by doubt would produce most regret (129 out of 154 or 84%). This pattern did not statistically differ from the control conditions, χ^2 (1, $N = 299$) = 1.65, $p = .19$, $\varphi = .08$. Importantly, in the *inaction-doubt conditions* (in which the person who decided *not* to act started doubting his decision), the pattern reversed. In these conditions, people attributed most regret to the person who decided not to act (106 out of 155 or 68%). The difference between these conditions and the control conditions was statistically significant, χ^2 (1, $N = 300$) = 64.70, $p < .001$, $\varphi = .46$. In addition, comparing the inaction-doubt conditions with the action-doubt conditions also rendered a statistically significant difference, χ^2 (1, $N = 309$) = 86.04, $p < .001$, $\varphi = .52$. The results of three different studies consistently reversed one of the most robust findings in the domain of regret; the action effect. Overall, these findings support the hypothesis that post-decisional doubt increases the intensity of a person's regret when realizing that the outcome could have been better.

9. General discussion

Decisions often produce considerable levels of doubt and regret, yet little is known about how these experiences are related. In six studies, we consistently find that doubts arising *after* a decision (i.e., when people question whether they made the right choice) increase the intensity of regret. We find mixed results for the effect of post-decisional doubt on the experience of relief and no support for a relationship between pre-decisional doubts and regret. Let us elaborate on this later finding, before discussing the theoretical- and practical implications of the current research.

This latter finding, that pre-decisional doubt is unrelated to regret, is surprising as those who chose the wrong option after an instance of doubt were *closer* in choosing the right option than those who chose the wrong option without any hesitation. Following norm theory (Kahneman & Miller, 1986), this difference in closeness should have influenced regret differently. More specifically, a key proposition of norm theory is that people's emotional responses to events are influenced by the perceived closeness in attaining the outcome that did not materialize. For example, imagine two lottery players who did not win this month's jackpot (the winning ticket number was AB122). The first player's ticket number was ZK695 while the second player's number was AB123. Who is more upset? Although both players did not win the jackpot, these players differ in the ease with which they can imagine themselves winning a fortune. This is easier for the second player as he was only one number away from a lifetime of wealth. This example demonstrates the principle of 'closeness': the closer a person was in attaining the outcome that did not materialize, the stronger one's emotional response to the outcome that did materialize. Given that those who doubted between options (but eventually chose the wrong option) were *closer* in choosing the right option than those who chose the wrong option without any hesitation, norm theory would have predicted more regret for these individuals. Nonetheless, this is not what we find and several reasons may account for this (null) finding. First, some people may equate pre-decisional doubt with decision carefulness, a factor shown to attenuate the intensity of regret. For example, Reb and Connolly (2010) recently found that individuals who carefully reached their decision (by searching for additional information concerning the options under consideration) experienced less regret than those who decided carelessly. When some people equate pre-decisional doubt with decision carefulness, this might have mitigated the overall effect of pre-decisional doubt on regret. Second, although people may be conflicted which option to choose in the pre-decisional phase, full-blown doubt is typically experienced *after* having committed to one of the choice options. This reasoning follows from the proposition that doubt needs a preexisting decision (or belief) as reference point that is targeted when conflicting arguments become available that challenge the correctness of the decision. Given that no option has been selected yet in the pre-decisional phase (acting as reference point), doubt may therefore be generally mild in this phase (losing its predictive strength when the outcome is revealed). The results of our first study support this conjecture as decision makers indeed indicated that they experienced much less doubts before a decision (as opposed to after a decision).

Although no prior work has examined how doubt affects people's reactions to decision outcomes, recent research in other domains (social judgment and persuasion respectively) has given an increasing amount of attention to a related construct, *attitude certainty* (Abelson, 1988; Brandt, Evans, & Crawford, 2014; Gross, Holtz, & Miller, 1995; Petrocelli, Tormala, & Rucker, 2007; Tormala & Petty, 2002). Attitude certainty refers to the subjective belief that an attitude or opinion is correct and research has documented a variety of antecedents and consequences of this construct. For example, research has repeatedly demonstrated that a person's attitude certainty is increased when learning that others hold similar attitudes (e.g., Festinger, 1954, Visser & Mirabile, 2004), or after repeatedly expressing the attitude to oneself or others (e.g., Holland, Verplanken, & Knippenberg, 2003; Petrocelli et al., 2007). In terms of consequences, attitude certainty has been shown to result in more *persistence* and *resistance* when information becomes available that undermines the validity of the attitude (e.g., Petrocelli et al., 2007; Tormala & Petty, 2002). Although attitude certainty is primarily investigated in different domains, its insights are of great importance for understanding the workings of post-decisional doubt. For example, following the observed relationship between social support and attitude certainty, we would expect that decision-makers who learn that others made similar decisions experience less post-decisional doubt than those who learn that others favored an alternative course of action. In a similar vein, decision-makers who are certain that they made the correct decision are, in turn, hypothesized to be less likely to reverse their decision (i.e., more persistent) when information becomes available that suggests that the alternative option might be the better choice.

9.1. Theoretical implications

This research project started with the realization that, based on current theories of regret, diametrically opposite effects of post-decisional doubt on regret could be predicted. The finding that post-decisional doubt *increases* the intensity of regret is inconsistent with the conjecture that this type of doubt may already prepare people for the worst. Specifically, subjective expected pleasure theory (Mellers et al., 1999) argues that emotional reactions are less intense when outcomes are expected as opposed to unexpected. As a consequence, this account would have predicted *less* intense feelings of regret for those individuals who already questioned whether they made the correct decision (and for whom the aversive outcome thus did not come as a complete surprise). Instead, the results of our studies support the hypothesis based on decision justification theory (Connolly & Zeelenberg, 2002) and regret regulation theory (Zeelenberg & Pieters, 2007). Those who already doubted their decision felt more responsible for having made a poor choice and, consequently, experienced more regret (as compared to those who were certain that they made the correct decision). In what follows, we will discuss how our findings build upon and extend prior research within the domain of regret.

Prior research has identified a variety of factors that affect the intensity of regret. Early accounts emphasized the role of comparing

the decision outcome to outcomes associated with forgone options (e.g., Bell, 1982; Kahneman & Tversky, 1982; Loomes & Sugden, 1982; Savage, 1951) while more recent research also identified that the justifiability of the process is important in understanding regret. That is, people often regret the choice process leading to a decision, even when the outcome is good (Connolly & Zeelenberg, 2002; Pieters & Zeelenberg, 2005; Reb & Connolly, 2010; Zeelenberg & Pieters, 2007). However, in understanding the dynamics of regret, the abovementioned research has primarily focused on two distinct phases in the overall decision-making process. First, a pre-decisional phase in which regret is associated with the decision process and second, a post-outcome phase in which regret originates in comparing the decision outcome to the outcome of forgone options. Our results extend these findings by demonstrating that the intermediate period *between* a decision and its outcome is also of vital importance and research only recently began to recognize this notion. For example, Kirkebøen et al. (2013) demonstrated that people who revised their decision during these time periods experience more regret than those who chose the wrong option directly (see also, Kirkebøen & Teigen, 2011). We build upon these findings by showing that that even a brief instance of doubt during this period impacts the intensity of a person's regret when the outcome is revealed.

Although decisions often result in doubt and regret, research has largely ignored how these experiences are related. We suspect that this lack of attention is partly due to the (erroneous) assumption that post-decisional doubt forms an integral part of the regret profile. For example, the most widely used regret scale (i.e., the 5-items regret scale by Schwartz et al., 2002) includes an item that is more related to the experience of post-decisional doubt in our opinion ('Once I make a decision, I don't look back'). Including this item in the scale suggests, however, that theorists assume that post-decisional doubt is a defining feature of the experience of regret. Our results suggest otherwise and the findings of the first pilot study support this notion by highlighting how both experiences differ in their experiential content. The experience of post-decisional doubt is thus a process that is strongly associated to the intensity of regret but should be treated differently.

9.2. Practical implications

Regret, both experienced and anticipated, strongly affects decision making in various domains. That is, because regret is such an aversive emotion, it has been shown to influence investment decisions (Strahilevitz et al., 2011), risk preferences in the context of negotiations (Larrick & Boles, 1995), trust decisions (Martinez & Zeelenberg, 2015), and the persistence of individuals and organizations to continue investing valuable resources in failing courses of action (Wong & Kwong, 2007; Ku, 2008). For that reason, it is of vital importance to understand how other decision-related experiences, such as doubt, affect the intensity of regret. Because people experience more regret when they start doubting their decision, the negative consequences of regret can be attenuated by reducing this type of doubt. For example, in the context of organizations, reliable decision making tools like decision support systems (Stadtler, 2005), statistical forecasting tools (Goodwin & Fildes, 1999), or expert advisors (Sniezek & Van Swol, 2001) should reduce a decision-maker's degree of doubt in one's decision (and subsequent regret when the decision turns out to be less optimal). However, although lowering post-decisional doubt reduces the intensity of regret, there are also potential negative consequences. Specifically, if decision-makers have an intuition about the relationship between post-decisional doubt and regret, the desire to regulate and prevent regret could lead them to avoid important, conflicting information that may undermine their decision after a decision has been reached. While this strategy is successful in reducing post-decisional doubt (and thus regret when the negative outcome is revealed), the risk of having employees who are willingly ignorant may pose a serious threat to an organization.

10. Conclusion

Although doubt and regret often accompany one another in our decisions, research has remained mute with respect to how these experiences are related. The present research is an initial step towards understanding this relationship by studying how various types of doubt affect the intensity of a person's regret. Open questions for future research are (1) whether a prior experience of regret, in turn, affects a person's degree of doubt in subsequent decisions, (2) whether these instances of doubt also affect other prototypical decision-related emotions like disappointment, and (3) whether the relationship between doubt and regret interacts with dispositional traits like the tendency to maximize (Schwartz et al., 2002), neuroticism (Goldberg, 1992; Saucier, 1994), or trait anxiety (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1970). On a final note, the experience of doubt plays no role in classic economic theory as people choose by optimizing. Each choice alternative has a certain value and decision makers simply select the alternative with the highest value. As a result, people are assumed to always choose the best possible option and the experience of post-decisional doubt should therefore be a rarity according to this account. Our findings cast doubt on this premise by showing that such doubts occur frequently and have widespread consequences on how people respond to the outcome of decisions.

Appendix A

To obtain a deeper understanding of the effect of post-decisional doubt on regret, we also ran some additional, exploratory analyses (please note that these exploratory analyses were preregistered). Specifically, directly after answering the trivia-question, we asked participants whether their answer was a complete random guess or to a certain extent an informed decision.[12] In total, 71 participants indicated that their answer was a random guess while 191 participants indicated it to be an informed decision. We were interested if the effect of doubt on regret would differ between these two groups of participants.

As presented in the Table A1 (upper- vs. lower panel), including doubt to the model at stage 2 significantly improved the model when participants made an informed decision ($\Delta R^2 = .08$; $p < .001$), but *not* when their answer was a complete random guess ($\Delta R^2 = .05$; $p = .06$). Although randomly choosing a choice alternative induces doubt, this evidently did not feed into the experience of regret when learning the poor outcome. These results suggest that doubt originating from different sources impacts the intensity of regret differently. A possible reason for this finding might be that doubt impacts regret only for decisions for which people feel responsible, but not for choices in which doubt originates from a random process. Nonetheless, the exact reason underlying this pattern remains unclear and future research could address this interesting finding in more detail.

[12] We thank an anonymous reviewer for suggesting this distinction.

Table A1
Summary of the hierarchical multiple regression analyses for variables predicting regret as a function of whether the answer was a random guess or not, Study 3.

	Answer was a complete random guess (N = 71)					
	Stage 1			Stage 2		
Variables	*b*	*SE b*	β	*b*	*SE b*	β
Age	0.02	0.02	.16	0.01	0.02	.10
Gender (0 = Male, 1 = Female)	0.35	0.38	.11	0.19	0.38	.06
Pre-outcome regret	0.19	0.13	.17	0.16	0.13	.14
Post-decisional doubt				0.34	0.17	.24
R^2			.06			.11
F for change in R^2	1.45			3.75		
	Answer was to a certain extent an informed decision (N = 191)					
	Stage 1			Stage 2		
Variables	*b*	*SE b*	β	*b*	*SE b*	β
Age	0.00	0.01	−.01	0.00	0.01	.01
Gender (0 = Male, 1 = Female)	0.55	0.20	.19**	0.32	0.20	.11
Pre-outcome regret	0.29	0.11	.20**	0.15	0.11	.10
Post-decisional doubt				0.36	0.09	.30***
R^2			.07			.15
F for change in R^2	4.94**			16.53***		

*$p < .05$, **$p < .01$, ***$p < .001$.

Appendix B

Below first the 'home scenario' as used in Study 6. In the control condition, participants learned that Time decided to move whereas John decided not to move. In our second condition {between braces}, participants learned that Tim never questioned his decision for a minute whereas John started doubting his decision to move. In our third condition [between brackets], participants learned that Tim started doubting his decision not to move while John never questioned his decision to move for a minute.

Tim owns a home in 'Bellville'. During the past year he considered selling his house in order to move to 'Starville'. Tim decided not to move {and never questioned his decision for a minute} [but started questioning whether he made the right decision]. Today he finds out that the value of his house in Belleville has decreased by 10% while the average value of houses in Starville increased by 10%.

John owned a home in 'Starville'. During the past year he considered selling his house in order to move to 'Bellville'. John decided to move {but started questioning whether he made the right decision} [and never questioned his decision for a minute]. Today he finds out that the value of his house in Belleville has decreased by 10% while the average value of houses in Starville increased by 10%.

Below the 'hotel scenario' as used in Study 6, that follows the same logic.

Paul planned a trip to India and he booked a room at the The New Delhi. During the past month he considered switching to an adjacent hotel, The Bombay, which has identical room rates. Paul decided not to switch {and he never questioned his decision for a minute} [but started questioning whether he made the right decision]. Upon arrival he learns that The New Delhi is not that great while The Bombay is very comfortable.

George also planned a trip to India and he booked a room at The Bombay. During the past month he considered switching to an adjacent hotel, The New Delhi. George decided to switch {but started questioning whether he made the right decision} [and he never questioned his decision for a minute]. Upon arrival he learns that The New Delhi is not that great while The Bombay is very comfortable.

Appendix C. Supplementary material

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.obhdp.2018.08.006.

References

Abelson, R. P. (1988). Conviction. *American Psychologist, 43*, 267–275.

Bell, D. E. (1982). Regret in decision making under uncertainty. *Operations Research, 30*, 961–981.

Bell, D. E. (1983). Risk premiums for decision regret. *Management Science, 29*, 1156–1166.

Berg, J., Dickhaut, J., & McCabe, K. (1995). Trust, reciprocity, and social history. *Games and Economic Behavior, 10*, 121–142.

Bohnet, I., Greig, F., Herrmann, B., & Zeckhauser, R. (2008). Betrayal aversion: Evidence from Brazil, China, Oman, Switzerland, Turkey, and the United States. *American Economic Review, 98*, 294–310.

Boles, T. L., & Messick, D. M. (1995). A reverse outcome bias: The influence of multiple reference points on the evaluation of outcomes and decisions. *Organizational Behavior and Human Decision Processes, 61*, 262–275.

Brandt, M. J., Evans, A. M., & Crawford, J. T. (2015). The unthinking or confident extremist? Political extremists are more likely to reject experimenter-generated anchors than moderates. *Psychological Science, 26*, 189–202.

Breugelmans, S. M., Zeelenberg, M., Gilovich, T., Huang, W. H., & Shani, Y. (2014). Generality and cultural variation in the experience of regret. *Emotion, 14*, 1037–1048.

Connolly, T., & Zeelenberg, M. (2002). Regret and decision making. *Current Directions in Psychological Science, 11*, 212–216.

Coricelli, G., Critchley, H. D., Joffily, M., O'Doherty, J. P., Sirigu, A., & Dolan, R. J. (2005). Regret and its avoidance: A neuroimaging study of choice behavior. *Nature Neuroscience, 8*, 1255–1262.

Dasgupta, P. (1988). Trust as a commodity. In D. Gambetta (Ed.). *Trust, making and breaking cooperative relations* (pp. 49–72). Basil: Blackwell.

De Bondt, W. F. M., & Thaler, R. H. (1995). Financial decision-making in markets and

firms: A behavioral perspective. In R. A. Jarrow, V. Maksimovic, & W. T. Ziemba (Eds.). *Handbooks in operations research and management science: Finance* (pp. 85–410). Amsterdam: Elsevier.
Estes, R., & Hosseini, J. (1988). The gender gap on Wall Street: An empirical analysis of confidence in investment decision making. *Journal of Psychology, 122*, 577–590.
Festinger, L. (1954). A theory of social comparison processes. *Human Relations, 7*, 117–140.
Gilovich, T., & Medvec, V. H. (1995). The experience of regret: What, when, and why. *Psychological Review, 102*, 379–395.
Goldberg, L. R. (1992). The development of markers for the Big Five factor structure. *Psychological Assessment, 4*, 26–42.
Goodwin, P., & Fildes, R. (1999). Judgmental forecasts of time series affected by special events: Does providing a statistical forecast improve accuracy? *Journal of Behavioral Decision Making, 12*, 37–53.
Gross, S., Holtz, R., & Miller, N. (1995). Attitude certainty. In R. E. Petty, & J. A. Krosnick (Eds.). *Attitude strength: Antecedents and consequences* (pp. 215–245). Mahwah, NJ: Erlbaum.
Heath, C., & Gonzalez, R. (1995). Interaction with others increases decision confidence but not decision quality: Evidence against information collection views of interactive decision making. *Organizational Behavior and Human Decision Processes, 61*, 305–326.
Holland, R. W., Verplanken, B., & Van Knippenberg, A. (2003). From repetition to conviction: Attitude accessibility as a determinant of attitude certainty. *Journal of Experimental Social Psychology, 39*, 594–601.
Huang, W. H., & Zeelenberg, M. (2012). Investor regret: The role of expectation in comparing what is to what might have been. *Judgment and Decision Making, 7*, 441–451.
Inman, J. J., & Zeelenberg, M. (2002). Regret in repeat purchase versus switch decisions: The attenuating role of decision justifiability. *Journal of Consumer Research, 29*, 116–128.
Kahneman, D., & Miller, D. T. (1986). Norm theory: Comparing reality to its alternatives. *Psychological Review, 93*, 136–153.
Kahneman, D., & Tversky, A. (1982). The psychology of preferences. *Scientific American, 246*, 160–173.
Kiani, R., Corthell, L., & Shadlen, M. N. (2014). Choice certainty is informed by both evidence and decision time. *Neuron, 84*, 1329–1342.
Kirkebøen, G., & Teigen, K. H. (2011). Pre-outcome regret: Widespread and overlooked. *Journal of Behavioral Decision Making, 24*, 267–292.
Kirkebøen, G., Vasaasen, E., & Teigen, K. H. (2013). Revisions and regret: The cost of changing your mind. *Journal of Behavioral Decision Making, 26*, 1–12.
Kruger, J., Wirtz, D., & Miller, D. T. (2005). Counterfactual thinking and the first instinct fallacy. *Journal of Personality and Social Psychology, 8*, 725–735.
Ku, G. (2008). Learning to de-escalate: The effects of regret in escalation of commitment. *Organizational Behavior and Human Decision Processes, 105*, 221–232.
Landman, J. (1987). Regret and elation following action and inaction: Affective reactions to positive versus negative outcomes. *Personality and Social Psychology Bulletin, 13*, 524–536.
Larrick, R. P., & Boles, T. L. (1995). Avoiding regret in decisions with feedback: A negotiation example. *Organizational Behavior and Human Decision Processes, 63*, 87–97.
Lin, C. H., Huang, W. H., & Zeelenberg, M. (2006). Multiple reference points in investor regret. *Journal of Economic Psychology, 27*, 781–792.
Loomes, G., & Sugden, R. (1982). Regret theory: An alternative theory of rational choice under uncertainty. *Economic Journal, 92*, 805–824.
Martinez, L. F., & Zeelenberg, M. (2015). Trust me (or not): Regret and disappointment in experimental economic games. *Decision, 2*, 118–126.
McGraw, A. P., Mellers, B. A., & Tetlock, P. E. (2005). Expectations and emotions of Olympic athletes. *Journal of Experimental Social Psychology, 41*, 438–446.
Mellers, B. A., Schwartz, A., Ho, K., & Ritov, I. (1997). Decision affect theory: Emotional reactions to the outcomes of risky options. *Psychological Science, 8*, 423–429.
Mellers, B., Schwartz, A., & Ritov, I. (1999). Emotion-based choice. *Journal of Experimental Psychology: General, 128*, 332–345.
Paolacci, G., & Chandler, J. (2014). Inside the Turk: Understanding Mechanical Turk as a participant pool. *Current Directions in Psychological Science, 23*, 184–188.
Paolacci, G., Chandler, J., & Ipeirotis, P. G. (2010). Running experiments on Amazon Mechanical Turk. *Judgment and Decision Making, 5*, 411–419.
Petrocelli, J. V., Tormala, Z. L., & Rucker, D. D. (2007). Unpacking attitude certainty: Attitude clarity and attitude correctness. *Journal of Personality and Social Psychology, 92*, 30–41.
Pieters, R., & Zeelenberg, M. (2005). On bad decisions and deciding badly: When intention-behavior inconsistency is regrettable. *Organizational Behavior and Human Decision Processes, 97*, 18–30.
Reb, J., & Connolly, T. (2010). The effects of action, normality, and decision carefulness on anticipated regret: Evidence for a broad mediating role of decision justifiability. *Cognition and Emotion, 24*, 1405–1420.
Ritov, I. (1996). Probability of regret: Anticipation of uncertainty resolution in choice. *Organizational Behavior and Human Decision Processes, 66*, 228–236.
Ritov, I., & Baron, J. (1995). Outcome knowledge, regret and omission bias. *Organizational Behavior and Human Decision Processes, 64*, 119–127.
Roseman, I. J., Wiest, C., & Swartz, T. S. (1994). Phenomenology, behaviors, and goals differentiate discrete emotions. *Journal of Personality and Social Psychology, 67*, 206–211.
Saucier, G. (1994). Mini-markers: A brief version of Goldberg's unipolar Big-Five markers. *Journal of Personality Assessment, 63*, 506–516.
Savage, L. J. (1951). The theory of statistical decision. *Journal of the American Statistical Association, 46*, 55–67.
Schwartz, B., Ward, A., Monterosso, J., Lyubomirsky, S., White, K., & Lehman, D. R. (2002). Maximizing versus satisficing: Happiness is a matter of choice. *Journal of Personality and Social Psychology, 83*, 1178–1197.
Shimanoff, S. B. (1985). Expressing emotions in words: Verbal patterns of interaction. *Journal of Communication, 35*, 16–31.
Sniezek, J. A., & Van Swol, L. M. (2001). Trust, confidence, and expertise in a judge–advisor system. *Organizational Behavior and Human Decision Processes, 84*, 288–307.
Spielberger, C. D., Gorsuch, R. L., & Lushene, R. E. (1970). *Manual for the State-Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychologists Press.
Stadtler, H. (2005). Supply chain management and advanced planning: Basics, overview and challenges. *European Journal of Operational Research, 163*, 575–588.
Strahilevitz, M., Odean, T., & Barber, B. M. (2011). Once burned, twice shy: How naive learning, counterfactuals, and regret affect the repurchase of stocks previously sold. *Journal of Marketing Research, 48*, 102–120.
Tormala, Z. L., & Petty, R. E. (2002). What doesn't kill me makes me stronger: The effects of resisting persuasion on attitude certainty. *Journal of Personality and Social Psychology, 83*, 1298–1313.
Van Dijk, E., & Zeelenberg, M. (2005). On the psychology of "if only": Regret and the comparison between factual and counterfactual outcomes. *Organizational Behavior and Human Decision Processes, 97*, 152–160.
Visser, P. S., & Mirabile, R. R. (2004). Attitudes in the social context: The impact of social network composition on individual-level attitude strength. *Journal of Personality and Social Psychology, 87*, 779–795.
Wong, K. F. E., & Kwong, J. Y. Y. (2007). The role of anticipated regret in escalation of commitment. *Journal of Applied Psychology, 92*, 545–553.
Zeelenberg, M. (2009). Relief. In D. Sander, & K. R. Scherer (Eds.). *The oxford companion to emotion and the affective sciences* (pp. 340). New York, NY: Oxford University Press.
Zeelenberg, M., Beattie, J., Van der Pligt, J., & De Vries, N. K. (1996). Consequences of regret aversion: Effects of expected feedback on risky decision making. *Organizational Behavior and Human Decision Processes, 65*, 148–158.
Zeelenberg, M., & Pieters, R. (2004). Consequences of regret aversion in real life: The case of the Dutch postcode lottery. *Organizational Behavior and Human Decision Processes, 93*, 155–168.
Zeelenberg, M., & Pieters, R. (2007). A theory of regret regulation 1.0. *Journal of Consumer Psychology, 17*, 3–18.
Zeelenberg, M., Van Dijk, W. W., & Manstead, A. S. R. (1998). Reconsidering the relation between regret and responsibility. *Organizational Behavior and Human Decision Processes, 74*, 254–272.
Zeelenberg, M., Van den Bos, K., Van Dijk, E., & Pieters, R. (2002). The inaction effect in the psychology of regret. *Journal of Personality and Social Psychology, 82*, 314–327.